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To: Professor Ernest O. Lawrence

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The possible sources of radiation injury from the explosion of an atomic bomb are as follows.

1. External radiation from the actual explosion and rapidly expanding cloud of fission products.

2. External radiation from fission products deposited on soil, buildings, roads, vegetation, etc. as the result of a nearby underwater explosion or an explosion less than 200 feet from the ground.

3. Inhalation of contaminated air from situation #2 before the radioactive material has settled out.

4. Inhalation of air contaminated by dust, etc. from an area that has become radioactive from situation #2.

It is desirable to consider the 4th situation in some detail. Let it be assumed that a 10 kilogram plutonium bomb is exploded with an efficiency of 10%. Thus, there will be 1 kilogram of fission products whose gross radioactivity will be 20, 5, and .2 megacuries at 5, 50 and 500 days after the explosion. The 9 kilograms of plutonium that failed to undergo fission will have a total radioactivity of approximately 500 curies. The amount of inhaled fission product activity to produce a lethal effect by lung injury is estimated to be 30, 15, and 5 millicuries respectively at the indicated three time intervals. The corresponding value for plutonium is estimated to be in the range of 250 microcuries. The relative contribution of plutonium to the lethal action of the fission products is .3%, 2%, and 5% at the 5, 50, and 500 day time intervals. Thus it is apparent that only after a period of many years will an infected area present more of a potential hazard from plutonium than the ever diminishing amount of fission products. Conversely, the role of plutonium in the production of internal radiation injury diminishes to the vanishing point the shorter the interval becomes between the explosion and the inhalation of the contaminated air.

A useful and practical appraisal of the relative menace of external and internal injury is complicated to say the least. At any event, plutonium will play no role as a source of external radiation

and is of relatively minor importance as an internal radioactive poison under the probable circumstances surrounding its military applications. Under situation #3, namely the inhalation of contaminated spray or dust immediately after the explosion, it is possible that a considerable fraction of the inhaled fission products and their radioactive descendants would be absorbed through the lungs to be deposited and retained by the skeleton. Under these conditions, estimates of lethal dosage levels are difficult, but plutonium is of no importance; the internal damage would be from the fission products. However, the external radiation from the cloud of spray or dust might well provide a lethal exposure before sufficient material had been inhaled to produce a killing effect.

It may be of interest to present an estimate of the number of bombs of the present type which might be expected to produce near lethal effects over wide areas by action of the released fission products. For the continental United States I believe that this level would be produced by approximately 50,000 bombs. A total global contamination would require of the order of 3,000,000 bombs.

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JGH:mmn
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